

REMARKS

This response is intended as a complete response to the Office Action dated June 5, 2006. In view of the following discussion, the Applicants believe that all claims are in allowable form.

CLAIM REJECTIONS

A. 35 USC §103 Claims 1-3, and 10

Claims 1-3, and 10 stand rejected under 35 USC. §103(a) as being unpatentable over U.S. Patent Application Publication No. 2003/0127319 to *Demaray, et al.* (hereinafter *Demaray*). In response, the Applicants have amended independent claim 1 to more clearly recite aspects of the invention.

Claim 1, as amended, recites limitations not taught or suggested by any combination of the cited art. *Demaray* discloses a physical vapor deposition (PVD) process utilizing “radio frequency (RF) sputtering of a wide target in the presence of a sputtering gas under a condition of uniform target erosion.” (*Demaray*, p. 1, ¶ [0009].) The RF sputtering process may be a dual frequency RF sputtering process, in which a low frequency RF power is applied to the target to bombard a substrate with ions from the plasma and in which a higher frequency RF power is applied to the target to accelerate electrons in the plasma and sputter the target material. (*Id.*, p. 5, ¶ [0043].)

However, *Demaray* fails to teach or suggest any interaction between the first and second RF signals applied to the target – *Demaray* merely discloses that each signal is utilized to provide independent benefits in the disclosed PVD process. Moreover, *Demaray* fails to teach or suggest that such an interaction may be utilized to control any characteristics of the plasma. In addition, the teachings of *Demaray* relate to applying dual frequency signals to a target in a PVD chamber. Accordingly, *Demaray* fails to teach or suggest supplying a first RF signal to a first electrode disposed in an etch processing chamber; and supplying a second RF signal to the first electrode, wherein an interaction between the first and second RF signals is used to control at least one

characteristic of a plasma formed in the etch processing chamber, as recited in amended claim 1. As such, a *prima facie* case of obviousness has not been established because *Demaray* fails to teach or suggest the limitations recited in amended claim 1. Thus, claim 1 is patentable over *Demaray*.

Moreover, with respect to claim 2, the Applicants respectfully disagree with the Examiner's rejection. The Examiner contends that the teachings of *Demaray* read on Applicant's claim "where the dual frequency causes a sheath modulation." However, claim 2 does not recite that the dual frequency causes a sheath modulation, as asserted by the Examiner. Claim 2 further limits claims 1 by reciting, "wherein the plasma characteristic [controlled by the interaction between the first and second RF signals] is at least sheath modulation."

In addition, the portions of *Demaray* cited by the Examiner relate to different aspects of the PVD process. Specifically, paragraph [0043] relates to the effects of the dual frequencies applied to the PVD target, while paragraph [0047] discusses the plasma sheath formed when a bias power is applied to a substrate. As such, *Demaray* not only fails to teach or suggest any interaction between the first and second RF signals, but further fails to teach or suggest that any interaction between the first and second RF signals have any effect on the plasma sheath. Accordingly, *Demaray* fails to teach or suggest that any interaction between the first and second RF signals is used to control at least sheath modulation of the plasma, as recited by claim 2. Thus, claim 2 is further patentable over *Demaray*.

With respect to claim 10, the Applicants respectfully disagree with the Examiner's rejection. Specifically, the Examiner states that *Demaray* uses "dual frequency for the target to improve film characteristics as well as film uniformity which is an attribute of power distribution uniformity," citing *Demaray*, ¶[0023]. (Office Action, p. 4, ll. 9-11.) *Demaray* teaches to deposit a uniform film through a uniform target erosion obtained in one of two disclosed ways: diode sputtering, or a magnetron sputtering process. (*Demaray*, p. 3, ¶¶ [0029]-[0030].)

However, *Demaray* fails to teach or suggest controlling the power distribution within the plasma, let alone controlling the power distribution within the plasma via an interaction between the first and second RF signals. Accordingly, *Demaray* fails to teach or suggest that any interaction between the first and second RF signals is used to control at least a power distribution within the plasma, as recited by claim 10. Thus, claim 10 is further patentable over *Demaray*.

Thus, the Applicants submit that independent claim 1, and claims 2, 3, and 10 depending therefrom, are patentable over *Demaray*. Accordingly, the Applicants respectfully request that the rejection be withdrawn and the claim allowed.

B. 35 USC §103 Claims 4-9 and 11-12

Claims 4-9 and 11-12 stand rejected under 35 USC §103 as being unpatentable over *Demaray*, and further in view of *Georgieva et al.*, Journal of Applied Physics, V. 94, No. 6, Sept. 15, 2003, pgs 3748-3756 (hereinafter *Georgieva*). The Applicants respectfully disagree.

Independent claim 1, from which claims 4-9, 11 and 12 depend, recites limitations not taught or suggested by any permissible combination of the cited art. The patentability of claim 1 over *Demaray* is discussed above. *Georgieva* is cited to assert various effects of dual frequency RF on a plasma. However, *Georgieva* generally compares single frequency processing to a dual frequency processing. Specifically, *Georgieva* discloses potential and electric field distributions, electron and ion density distributions, and electron and ion energy distributions for single and dual frequency plasma processing. However, *Georgieva* fails to teach or suggest utilizing an interaction between the frequencies applied in a dual frequency chamber to control plasma properties. As such, *Georgieva* fails to teach or suggest a modification to the teachings of *Demaray* that would yield the limitations recited in claim 1. As such, a *prima*

facie case of obviousness has not been established as the combination of the cited references fails to yield the limitations recited in the claims.

Moreover, with respect to claim 4, the Examiner asserts that “with the proper choice of the above parameters, one of ordinary skill in the art would be able to obtain an IEDF of any desired shape....” However, the Applicants note that in order to satisfy the burden of creating a *prima facie* case of obviousness, there must be some motivation or suggestion in the cited references, or in the general knowledge available to one of ordinary skill in the art at the time the invention was made, to modify the reference(s) in a manner that would yield the claimed invention. (*MPEP* §2142, citing *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).) “The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination.” (*MPEP* §2143 III, citing *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990).)

In this instance, a *prima facie* case of obviousness has further not been established as the Examiner has not provided a motivation or suggestion to combine the references in a manner that would yield the limitations recited in claim 4. The Examiner has similarly not provided any motivation to modify *Demaray* in view of *Georgieva* with respect to the limitations recited in claims 5-6. In addition, with respect to claim 6, the Applicants rely on the plain meaning of the term “peak-to-peak” sheath voltage and submit that no special definition is required.

With respect to claims 11-12, the Applicants note that Figures 2-3 of *Georgieva* depict “simulation results of potential and electric-field distribution in single- and dual-frequency regime, respectively.” (*Georgieva*, p. 3752, ll. 12-14; Figs. 2-3.) These graphs depict potential and electric-field distributions as a function of phase (time) and position (distance from the driven electrode) for a single frequency (Figure 2) and from a dual frequency (Figure 3) chamber. However, *Georgeiva* fails to teach or suggest how spatial distributions may vary as a function of frequency. Accordingly, *Georgeiva* fails to teach or suggest a

modification to the teachings of *Demaray* that would result in a process wherein the first and second RF signals provide similar plasma excitation properties and different spatial uniformity profiles, as recited in claim 11. In addition, *Georgeiva* fails to discuss the results any interaction between the two RF signals over a range of frequencies and/or power ratios. *Georgeiva* further fails to discuss the results any such interaction between the two RF signals may have on the power distribution in the plasma. Accordingly, *Georgeiva* further fails to teach or suggest a modification to the teachings of *Demaray* that would result in a process wherein the interaction between the first and second RF signals is a varying effect on the power distribution in the plasma, as recited in claim 12.

Thus, the Applicants submit that claims 4-9, 11-12 are patentable over *Demaray*, and further in view of *Georgieva*. Accordingly, the Applicants respectfully request that the rejection be withdrawn and the claims allowed.

C. 35 USC §103 Claims 13 and 33

Claims 13 and 33 stand rejected under 35 USC §103 as being unpatentable over *Demaray*, in view of *Georgieva*, and in further view of *Lieberman et al.* (Plasma Sources Sci. Technol., 11 (2002), pages 283-293) (hereinafter *Lieberman*). The Applicants respectfully disagree.

Independent claim 1, from which claims 13 and 33 depend, recites limitations not taught or suggested by any permissible combination of the cited art. The patentability of claim 1 over *Demaray* in view of *Georgieva* is discussed above. *Lieberman* is cited to show that radial plasma electric field distribution is different for varying frequencies. However, *Lieberman* fails to teach or suggest supplying a first RF signal to a first electrode disposed in an etch processing chamber and supplying a second RF signal to the first electrode, wherein an interaction between the first and second RF signals is used to control at least one characteristic of a plasma formed in the etch processing chamber, as recited in amended claim 1. Accordingly, *Lieberman* fails to teach or suggest a modification to the combination of *Demaray* in view of *Georgieva* that would yield

the limitations recited in claim 1. Thus a *prima facie* case of obviousness has not been established as the combination of the cited references fails to yield the limitations recited in the claims.

Furthermore, with respect to claim 13, the Examiner asserts that “it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the method of *Demaray* to obtain even higher uniformity by selecting the proper parameters for the plasma and combining complementary first and second frequencies energy distributions to obtain an net radial power distribution that is substantially uniform.” (Office Action, p. 8) (emphasis added). However, no cited reference teaches or suggests how selecting or controlling the proper parameters for the plasma is performed.

The Federal Circuit has repeatedly held that “obvious to try” rationale is impermissible and an improper rationale for obviousness where it requires “vary[ing] all parameters or try[ing] each of numerous possible choices until one possibly arrive[s] at a successful result, where the prior art [gives] either no indication of which parameters [are] critical or no direction as to which of many possible choices is likely to be successful.” See *e.g.*, *In re O’Farrell*, 853 F.2d 894, 903 (Fed. Cir. 1988). In the present Office Action, the Examiner has not cited a reference that gives any indication of critical parameters, or direction as to which of many possible choices will yield the limitations of claim 13. As such, a *prima facie* case of obviousness has not been established as the combination of the cited references fails to yield the limitations recited in the claims. Moreover, as noted above, “[t]he mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination.” (MPEP §2143 III, citing *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990).)

Thus, the Applicants submit that claims 13 and 33 are patentable over *Demaray*, in view of *Georgieva*, and in further view of *Lieberman*. Accordingly, the Applicants respectfully request that the rejection be withdrawn and the claims allowed.

D. 35 USC §103 Claim 14

Claim 14 stands rejected under 35 USC §103 as being unpatentable over U.S. Patent Application Publication No. 2003/0148611 to *Dhindsa, et al.* (hereinafter *Dhindsa*), in view of *Demaray*, in view of *Georgieva*, and in further view of *Lieberman*. The Applicants respectfully disagree.

Claim 1, from which claim 14 depends, recites limitations not taught or suggested by any combination of the cited art. The patentability of claim 1 over the combination of *Demaray*, in view of *Georgieva*, and in further view of *Lieberman* is discussed above.

Dhindsa discloses a dual electrode processing chamber, utilizing confinement rings, a focus ring, and a shield, wherein the second electrode is coupled to a dual frequency RF power source. Specifically, *Dhindsa* discloses that the “presence of the focus ring [and the confinement rings] allows the equipotential field lines to be disposed substantially uniformly over the entire surface of the wafer.” (p. 3, ¶ [0032]). *Dhindsa* discloses that the “presently-claimed configuration,” including the focus ring, confinement rings, and shield, is required to achieve substantially improved etch rate uniformity. (p. 3, ¶ [0036]).

Dhindsa fails to disclose, suggest or teach a method “wherein the interaction between the first and second RF signals is used to control the uniformity of a plasma enhanced etch process” as recited by claim 14.

Also, obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art. MPEP §2143.01. The Examiner fails to assert any teaching, suggestion, or motivation to combine the cited references. The Examiner cites it would be obvious to use the apparatus of *Dhindsa* to control the uniformity of an etch process because *Dhindsa* discloses such a method. However, the *Dhindsa* discloses a different method for controlling an etch process and fails to teach or suggest a modification of the primary references in

a manner that would yield the limitations recited in the claims. As such, a *prima facie* case of obviousness has not been established because the combination of the cited references fails to yield the limitations recited in claim 14 and further because no motivation exists for the modification proposed by the Examiner.

Thus, the Applicants submit that claim 14 is patentable over *Dhindsa*, in view of *Demaray*, in view of *Georgieva*, and in further view of *Lieberman*. Accordingly, the Applicants respectfully request that the rejection be withdrawn and the claim allowed.

E. 35 USC §103 Claims 34-35 and 37-39

Claims 34-35 and 37-39 stand rejected under 35 USC §103 as being unpatentable over *Dhindsa* in view of *Lieberman*. The Applicants respectfully disagree.

The teachings of both *Dhindsa* and *Lieberman* are discussed above. Neither *Dhindsa* nor *Lieberman*, alone or in combination teach or suggest all of the limitations recited in either of independent claims 34 or 37. Specifically, the cited references do not suggest or teach determining a desired energy distribution of the plasma and producing the desired energy distribution through a controlled interaction between a first and a second RF signal applied to a first electrode disposed in a processing chamber, as recited in claim 34, or supplying a first RF signal at a first power level to a first electrode disposed in an etch chamber and controlling the application of a second RF signal at a second power level to the first electrode to produce a desired power distribution in the plasma, as recited in claim 37.

The Examiner supports the obviousness rejection by stating that one of ordinary skill in the art could “further improve the method of *Dhindsa* by determining the desired energy distribution and selecting the proper conditions to form a resulting energy distribution...”

However, the Examiner is improperly using the Applicants’ own claimed limitations as the justification for making the obviousness rejection. As the

Examiner is aware, the cited references must disclose, suggest, or teach the claimed limitations at the time of the invention, without impermissible hindsight in view of the Applicants' disclosure. MPEP §§ 2142 and 2141.01(III). As such, a *prima facie* case of obviousness has not been established as the combination of the cited references fails to yield the limitations recited in the claims without impermissible hindsight.

The Examiner further contends that one skilled in the art would be motivated to optimize through routine experimentation of the power ratio between the two signals, citing MPEP §2144.05(II)(B). However, as the Examiner is aware, "[a] particular parameter must first be recognized as a result-effective variable... before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation." (*Id.*, citing, *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977).) In this instance, no references show that the power ratio between the two RF signals is a result-effective variable. Accordingly, claims 34-35 and 37-39 are further patentable over the cited art.

Thus, the Applicants submit that claims 34-35 and 37-39 are patentable over *Dhindsa* in view of *Lieberman*. Accordingly, the Applicants respectfully request that the rejection be withdrawn and the claims allowed.

F. 35 USC §103 Claim 36

Claim 36 stands rejected under 35 USC §103 as being unpatentable over *Dhindsa*, in view of *Lieberman* and *Georgieva*. The Applicants respectfully disagree.

Independent claim 34, from which claim 36 depends, recites limitations not taught or suggested by any permissible combination of the cited art. The patentability of claim 34 over *Dhindsa*, in view of *Lieberman* is discussed above. Each reference discloses providing a specific set of frequencies by a dual frequency power source, i.e., *Dhindsa* (2MHz and 27 MHz), *Georgieva* (27 MHz and 2MHz), and *Lieberman* (13.56 MHz and 40.7 MHz).

The Applicants note that the Examiner relies on *Demaray* disclosing a specific set of frequencies by a dual frequency power source (13.56 MHz and 100-400 KHz) in the body of the rejection as a supporting reference in combination with the other references, without citing *Demaray* in the statement of the rejection. As the Examiner is aware, “where a reference is relied on to support a rejection, whether or not in a minor capacity, that reference should be positively included in the statement of the rejection.” MPEP §706.02(j), (citing *In re Hoch*, 428 F.2d 1341, 1342 n.3 166 USPQ 406, 407 n. 3 (CCPA 1970)). The Applicants presume that the Examiner intended to include *Demaray* in the statement of the rejection and address the reference accordingly. Accordingly, the Applicants treat this rejection as *Dhindsa*, in view of *Lieberman*, *Georgieva*, and *Demaray*.

No combination of the cited references disclose, suggest or teach applying about a 2 MHz frequency and about a 13.56 MHz frequency from a first and second RF source, respectively, to a first electrode, as recited in claim 36. The Examiner supports this rejection by stating “one who is skilled in the art would be motivated to optimize through routine experimentation of frequency mixing using commercially available RF power supplies,” citing MPEP §2144.05(II)(B).

In considering whether optimization through routine experimentation is proper support for an obviousness rejection, the CCPA has held that “[i]n determining whether or not such experimentation is within the teachings of the art, we must be ever alert not to read obviousness into an invention on the basis of the [Applicants’] own statements; that is, we must view the prior art without reading into that art [Applicants’] teachings. In re Waymouth, 499 F.2d 1273, 1276 (C.C.P.A. 1974). The Examiner asserts that *Demaray* discloses that the highest ion bombardment is obtained at a lowest frequency, and that *Georgieva* and *Lieberman* disclose that different frequencies have different energy distributions.

However, there is no disclosure, suggestion, or teaching in any of the cited references of determining a desired energy distribution of the plasma and

producing the desired energy distribution through a controlled interaction between a first and a second RF signal applied to a first electrode disposed in a processing chamber, wherein the first RF signal has a frequency of about 2 MHz and the second RF signal has a frequency of about 13.56 MHz as recited by claim 36. As such, the Applicants' method of controlling characteristics of a plasma can not be determined through "routine experimentation" taught by the prior art. As such, a *prima facie* case of obviousness has not been established as the combination of the cited references fails to yield the limitations recited in the claims

Thus, the Applicants submit that claim 36 is patentable over *Dhindsa*, in view of *Lieberman*, *Georgieva*, and *Demaray*. Accordingly, the Applicants respectfully request that the rejection be withdrawn and the claim allowed.

NEW CLAIMS

The Applicants have added new claims 40-46 to the present application. Claims 40-46 are supported by the specification and add no new matter. Claim 40 further limits independent claim 1 by reciting, "wherein the first electrode is disposed beneath a substrate support surface in the etch chamber." Claims 43 and 45 similarly limit independent claims 34 and 37, respectively. Claim 41 further limits dependent claim 40 by reciting, "wherein the electrode is a cathode." Claims 42, 44, and 46 respectively further limit claims 40, 43, and 45, by reciting, "etching a substrate disposed on the substrate support surface."

The Applicants submit that these limitations are further patentable over the references cited herein. Accordingly, the Applicants respectfully request entry and allowance of these new claims.

CONCLUSION

Thus, the Applicants submit that all claims now pending are in condition for allowance. Accordingly, both further consideration of this application and its swift passage to issue are earnestly solicited.

If, however, the Examiner believes that any unresolved issues still exist, it is requested that the Examiner telephone Alan Taboada at (732) 935-7100 so that appropriate arrangements can be made for resolving such issues as expeditiously as possible.

Respectfully submitted,

September 5, 2006

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